

PROJECT facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

ADVANCED CLEAN/EFFICIENT
POWER systems

PS026.0897M

SOLID OXIDE FUEL CELL PROJECT GENERATING TOMORROW'S ELECTRICITY CLEANLY

PRIMARY PROJECT PARTNER

Westinghouse Electric Corporation
Pittsburgh, PA

MAIN SITES

Westinghouse Science and Technology Center
Pittsburgh, PA

Southern California Edison
Los Angeles, CA

Environmental Protection Agency
Forte Meade, MD

Ontario Hydro
Ontario Canada

COST

\$202,550,978

COST SHARING

DOE \$82,903,796

Non-DOE \$119,647,182

Project Description

Westinghouse Electric Corporation is developing the tubular ceramic-based oxide fuel cell, which are one of the simplest, cleanest, most efficient, and most versatile technologies on the power-generation horizon. Westinghouse is widely recognized as the world leader in this promising new technology.

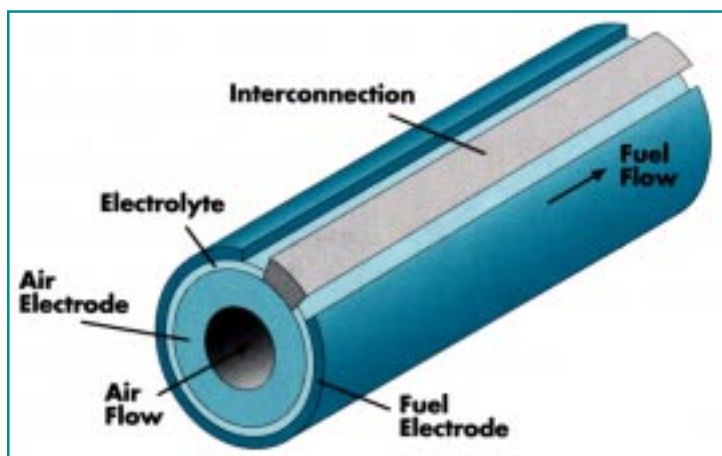
The \$200-million effort — 59% of the funding is coming from the private sector — is a 5-year development project aimed at moving this 21st century technology up to the threshold of commercial use.

Like a battery, the solid oxide fuel cell generates power electrochemically, avoiding the air pollutants and efficiency losses associated with combustion processes. Unlike batteries, fuel cells operate continuously, generating power as long as natural gas, clean coal-derived gas, or other hydrocarbon fuels as supplied. The solid electrolyte allows for the simplest of fuel cell plant designs, and requires no external fuel reforming.

The solid oxide concept uses ceramics, which allows the cells to operate at higher temperatures than other fuel cells, producing more energy per unit of fuel and far less carbon dioxide (a greenhouse gas). The high exhaust temperature and pressurization potential of the Westinghouse design make it particularly suited for multiple combined cycles and high efficiencies.

Westinghouse's configuration is a tube made up of multiple ceramic layers bonded together. Multiple tubes link to form power modules; modules link to form small generators or submodules for larger power plants.

The development effort will culminate in tests of a 250-kilowatt fuel cell-micro turbine combined cycle power plant, a 800-kilowatt fuel cell-turbine combined cycle power plant, a 1,300 kilowatt fuel cell-turbine combined cycle power plant, and a 2500-kilowatt fuel cell-turbine combined cycle power plant. These modules will be tested at utility and industrial sites.



SOLID OXIDE FUEL CELL PROJECT

GENERATING TOMORROW'S ELECTRICITY CLEANLY

Program Goals

Commercialization of the Westinghouse concept — the only fuel cell type in which American technology clearly leads the world — could offer a new approach to generating power in the United States and worldwide. It could create a new solid state manufacturing industry, employing skilled workers to design and fabricate power technologies for tomorrow's energy needs.

The program goals are to commercialize the tubular SOFC by 2002. Commercialization of the technology supports DOE goals for emissions reduction and energy security.

Project Benefits

The solid oxide fuel cell is one of the cleanest, most-efficient power-generating technologies now being developed.

Capable of using either natural gas or clean coal gas, it emits no sulfur pollutants and as much as 60%-65% less carbon dioxide (a greenhouse gas) than a conventional coal-burning plant.

It is also one of the most efficient means for generating electricity and usable heat. As simply cycle power generator, it can convert more than 55% of the energy in its fuel source to electricity (conventional coal plants, for example, operate at efficiencies of 33%-35%). When the quality waste heat from the electrochemical process is used, overall efficiencies could reach 85%. When utilized with a gas turbine in a combined power system, efficiencies over 70% can be achieved.

Because they involve no liquid or moving parts, solid oxide modules are expected to operate reliably for many years. A unit that can generate 2 megawatts of electricity, enough for a small substation, can fit on under one-tenth of an acre, allowing it to be placed closed to power needs, avoiding long transmission lines.

With a simple adjustment of air and fuel flows — much as a gas pedal is used in a car — a solid oxide fuel cell can easily follow changing demands for electricity, boosting output when necessary, then cycling down when demand is low.

The all-solid-state composition of these fuel cells promises to bring to the electric power sector the mass-production processes that have reduced the costs in the electronics industry.

The clean environmental performance of solid oxide fuel cells make them especially well-suited for areas with strict air quality requirements. Future units could cogenerate electricity and steam for hospitals, shopping malls, and large residential or commercial complexes. Both urban centers and remote sites (for example, those with relatively low-cost fuel sources such as coal-bed methane operations) could be candidates for solid oxide fuel cells.

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